Space Weather Technical Forecast

Issued on Friday, 06 May 2022 at 01:23 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-class flares likely leading to R1/R2 radio blackouts. Chance of R3 from X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate over the past 24 hours, with GOES16 recording frequent C-class activity and two M2 flares at 05/1316 UTC and 05/1410 from AR3004 and AR3006 respectively. AR3004, in the western hemisphere is currently analysed as a Dkc/beta-gamma-delta, and AR3006 in the southeast quadrant a Dai/beta-delta. There are two other remaining numbered sunspots on the visible disc, AR2999 and AR3001, both stable and unipolar Hsx/Alpha. The Earth-facing side of the disc currently shows strongly demarcated striping in HMIBC imagery in the solar 'tropics', with the result that there are numerous filaments occupying these latitudes. At present all appear stable and there are no Earth-directed Coronal Mass Ejections (CMEs) in available satellite imagery.

Solar Wind / Geomagnetic Activity: The solar wind, followed a slow regime, with the speed at ACE generally between 300-400 km/s. The solar wind density was similarly unremarkable in low single-figures ppcc, while the IMF was stable at or below 6nT, with a north-south component of +4/-5nT. The phi angle was predominantly negative (towards the Sun). The resulting geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours. The high energy electron flux has varied between Moderate and High levels, reaching a peak of 1687 pfu at 05/1715 UTC. Electron fluence followed a slightly increasing trend, with the 05/2100 UTC observed 24-hour integrated value being 5.72e7pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Further M-class flares are likely from either AR3004 or AR3006, with a daily Chance of X-class. No significant groups leave the disc, while a new and potentially active region appears likely to rotate onto the southeast limb within the next day or two.

Solar Wind / Geomagnetic Activity: No coronal holes feature in this forecast, and Quiet geomagnetic activity is therefore most likely until very late tomorrow or more likely day 3 (8th) when a CME may arrive. This is a re-analysed CME, which left the Sun on the 3th, and could reach Earth leading to Unsettled to Active (Kp 3-4) and possibly G1/Minor Storm (Kp 5) conditions from late tomorrow and into day 3 (8th). During day 4 geomagnetic conditions are expected to decline to become Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is at Background levels, and is expected to continue at this level through the period. There is a daily Slight Chance of S1 or above as a result of 3004's westward advance.

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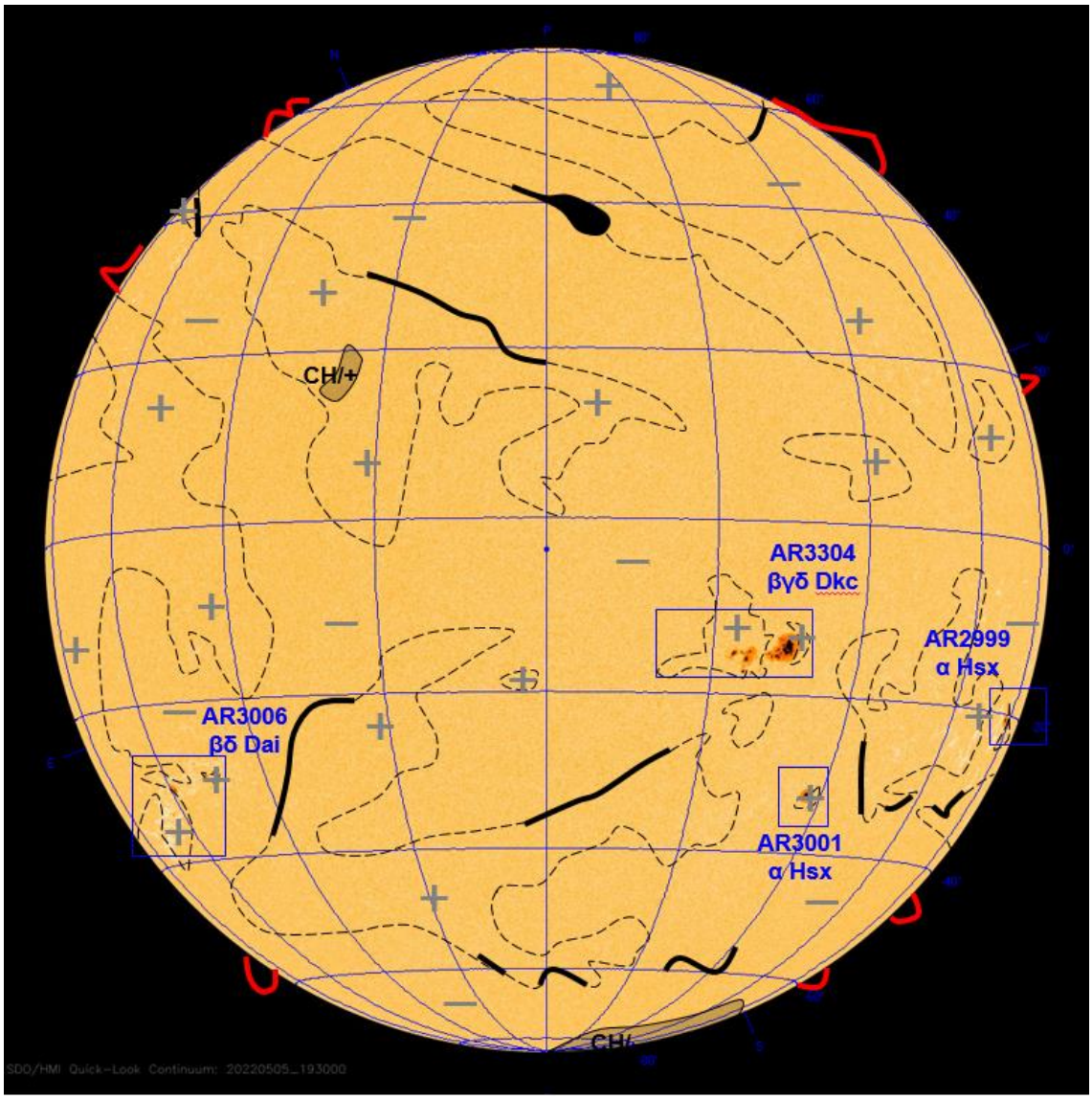
Met Office Space Weather Technical Forecast

The high energy electron flux (greater than 2MeV) is forecast to continue between Moderate and High in its diurnal oscillation, but with a gradual slight decline in fluence through the period in the unsupportive current solar wind environment. A daily Chance of Active fluence should therefore fall with time.

Figure 1. Solar Analysis Valid 05/1930 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No coronal holes feature in this forecast, and Quiet geomagnetic activity is therefore most likely until very late tomorrow or more likely day 3 (8th) when a CME may arrive. This is a re-analysed CME, which left the Sun on the 3th, and could reach Earth leading to Unsettled to Active (Kp 3-4) and possibly G1/Minor Storm (Kp 5) conditions from late tomorrow and into day 3 (8th). During day 4 geomagnetic conditions are expected to decline to become Quiet to Unsettled (Kp 1-3). However, confidence is low due to the poor imagery available for analysis, plus the modelled forecast arrival time assumes a high speed stream will be present at the same time as the CME arrival, and this will not be the case.

There are both numerous filaments on the disc at present, and AR3004 is within the western hemisphere. Should either of these sources produce CMEs, then the chances of some Earth-directed component are relatively high.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	30	40	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
04/0552 UTC	Partial	Unknown	NE quadrant	407 km/s	07/1800-2100 UTC	Low confidence

Figure 2: Latest Met Office ENLIL model (left) and ENLIL ensemble forecast (right).

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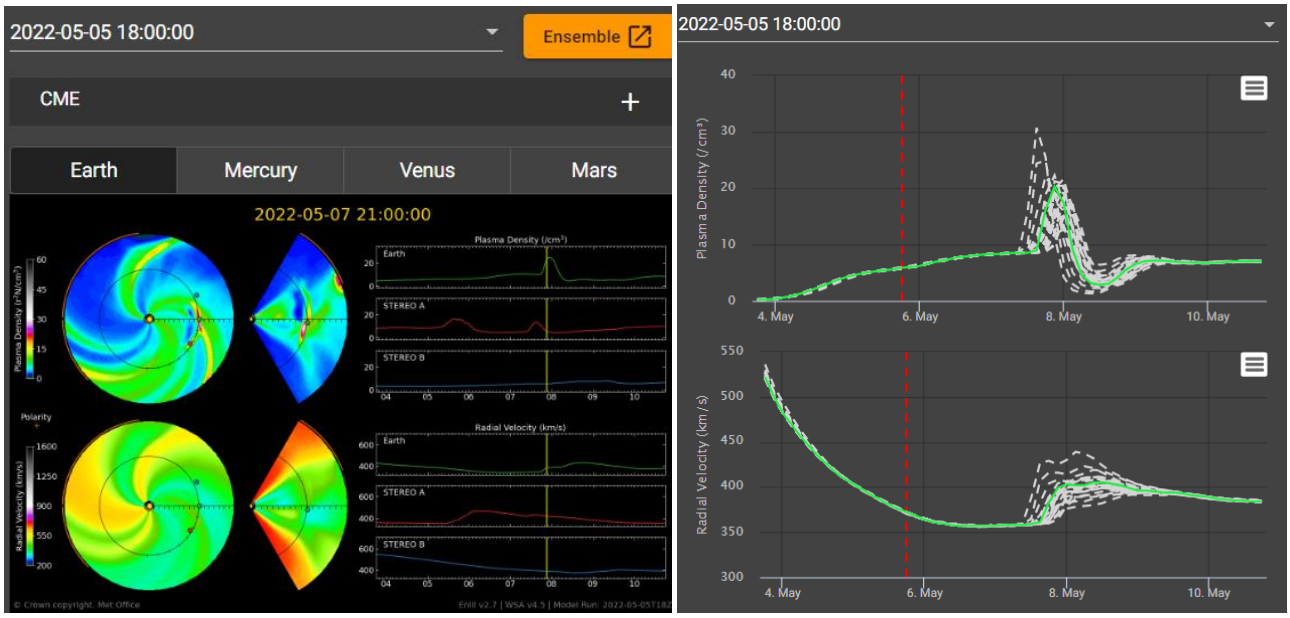

Radio Blackouts - X-Ray Flares:

There are currently four sunspots on the visible disc; AR3004 retains a delta spot immediately behind its leading spot, while some slight reduction in small intermediate spots has occurred, but it remains the largest and most complex region on the visible disc. AR3006 appears to have a delta spot in its trailing group, and some very faint intermediate spots have developed. AR3001 and AR2999 remain stable and inactive.

None of the significant regions leave the disc through the period, and therefore the forecast probabilities remain steady. Meanwhile STEREO A EUVI 195 imagery suggests a potentially active region will rotate onto the southeast limb within the next day or so.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	20	20	20	20

Figure 3: Stereo Ahead EUVI 195 image showing the potentially active region, expected to rotate onto the visible disc within the next few days.

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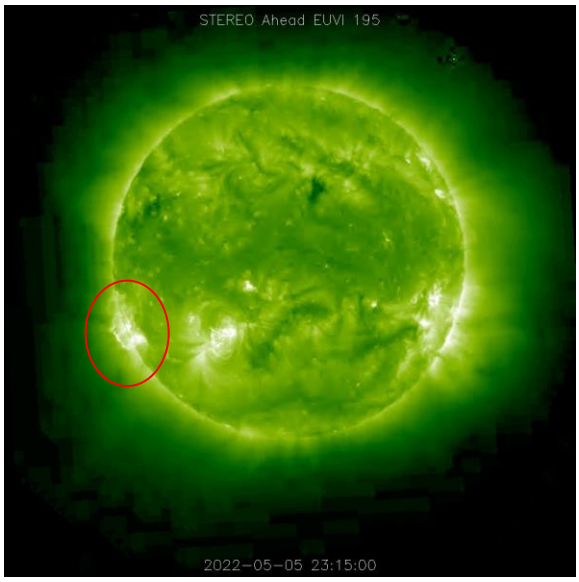

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at Background levels, and is most likely to remain so through the next four days.
There is a daily Slight Chance of S1 or above as a result of AR3004's advance across the western hemisphere.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) is forecast to continue between Moderate and High in its diurnal oscillation, but with a gradual slight decline in fluence through the period in the unsupportive current solar wind environment. A daily Chance of Active fluence (1e8 integrated flux) should therefore fall with time, especially with potential significant geomagnetic activity occurring either late tomorrow or through day 3 (8th).
The Met Office REFM model is considered to be offering good guidance, keeping the fluence below the Active threshold and with a declining trend.

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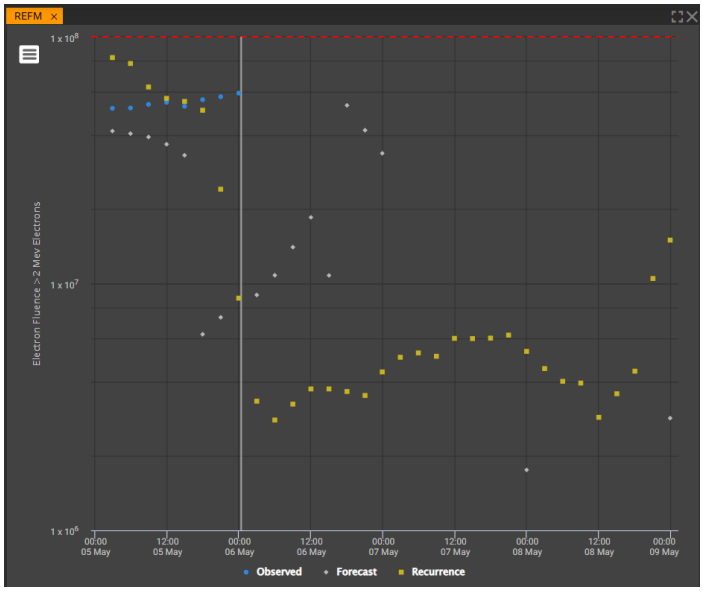
GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	40	30	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: Met Office REFM Model.

NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are; the inclusion of a recurrence graph, and the cadence of REFM forecast fluence data has been reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours.



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